



## TRANSLATION

I, Norio Matsui, residing at 2-4-38 Bunkyo, Sagamihara-shi, Kanagawa-ken, Japan, state:

that I know well both the Japanese and English languages;

that I translated, from Japanese into English, the specification, claims, abstract and drawings as filed in U.S. Patent Application No. 09/506,325, filed February 18, 2000; and

that the attached English translation is a true and accurate translation to the best of my knowledge and belief.

Dated: May 30, 2000

A handwritten signature in cursive script, appearing to read "N. Matsui", written over a horizontal line.

Norio Matsui



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## TITLE OF THE INVENTION

IMAGE FORMING APPARATUS

## BACKGROUND OF THE INVENTION

5 The present invention relates to an image forming apparatus for outputting a copy image, as in a case of printing images of two original documents on both sides of a single paper sheet with use of an OA (Office Automation) apparatus such as a copying machine.

10 In this copying machine, an original document is read by through-read, in which a read operation is effected by a stationary-type scanner which scans an original document, fed by an automatic document feeder (ADF), in units of one scan line.

15 The read image data is subjected to mirror-image conversion and recorded on a page memory. Then, after subjected to a rotational process, where needed, the image data is printed out.

20 In the prior art, there are directions of images, i.e. portrait/landscape, for each of a vertically positioned original and a horizontally positioned original.

25 The portrait of the vertically positioned original is defined such that the longitudinal direction of the original coincides with the up-and-down direction of the image. The portrait of the horizontally positioned original is defined such that the longitudinal direction of the original coincides with the up-and-down

direction of the image. The landscape of the vertically positioned original is defined such that the transverse direction of the original coincides with the up-and-down direction of the image. The landscape of  
5 the horizontally positioned original is defined such that the transverse direction of the original coincides with the up-and-down direction of the image.

As regards the above-mentioned copying machine, where images of two originals are printed on both sides  
10 of a single paper sheet, a process is performed with reference to an end face of a first original at which a final main scan is performed and an end face of a second original at which a first main scan is performed.

15 Consequently, in the case of the portrait of the vertically positioned original and the landscape of the vertically positioned original, the up-and-down direction of an image printed on the observe side coincides with the up-and-down direction of an image  
20 printed on the reverse side. However, in the case of the portrait of the horizontally positioned original and the landscape of the horizontally positioned original, the up-and-down direction of an image printed on the observe side is made opposite to the up-and-down  
25 direction of an image printed on the reverse side.

#### BRIEF SUMMARY OF THE INVENTION

The object of the present invention is to provide

an image forming apparatus wherein where images of two originals are printed on both sides of a single paper sheet, even in the case of the portrait of the horizontally positioned original and the landscape of the horizontally positioned original, the up-and-down direction of an image formed on the observe side is made to coincide with the up-and-down direction of an image formed on the reverse side.

In order to achieve this object, according to the present invention, there is provided an image forming apparatus for scanning images on first and second originals each having a main scan direction and a sub-scan direction and forming copy images of the scanning images on an obverse side and a reverse side of an image formation medium, the apparatus comprising: setting means for setting directions of scanning of the first and second originals; first scanning means for scanning the first original conveyed in the direction of scanning of the original set by the setting means; first recording means for recording image data of the first original scanning by the first scanning means; first reading means for reading out the image data of the first original recorded in the first recording means without rotating the image data; first image forming means for forming the image data of the first original reading by the first reading means on the obverse side of the image formation medium; second

scanning means for scanning the second original conveyed in the direction of scanning of the original set by the setting means; second recording means for recording image data of the second original read by the  
5 second scanning means; second reading means for reading out the image data of the second original recorded in the second recording means without rotating the image data or by rotating the image data over 180° in accordance with the setting by the setting means; and  
10 second image forming means for forming the image data of the second original reading by the second reading means on the reverse side of the image formation medium.

There is also provided an image forming apparatus  
15 for scanning images on first and second originals each having a main scan direction and a sub-scan direction and forming copy images of the scanning images on an obverse side and a reverse side of an image formation medium, the apparatus comprising: first setting means  
20 for setting directions of scanning of the first and second originals; second setting means for setting a binding margin; first scanning means for scanning the first original conveyed in the direction of scanning of the original set by the first setting means; first  
25 reading means for recording image data of the first original scanning by the first scanning means; first reading means for reading out the image data of the

first original recorded in the first recording means  
without rotating the image data and by providing the  
binding margin set by the second setting means; first  
image forming means for forming the image data of the  
5 first original reading by the first reading means on  
the obverse side of the image formation medium; second  
scanning means for scanning the second original  
conveyed in the direction of scanning of the original  
set by the setting means; second recording means for  
10 recording image data of the second original read by the  
second scanning means; second reading means for reading  
out the image data of the second original recorded in  
the second recording means without rotating the image  
data and by providing the binding margin set by the  
15 second setting means, or by rotating the image data  
over 180° and providing the binding margin set by the  
second setting means, in accordance with the setting by  
the setting means; and second image forming means for  
forming the image data of the second original reading  
20 by the second reading means on the reverse side of the  
image formation medium.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a cross-sectional view showing a  
schematic structure of a digital copying machine  
25 according to the present invention;

FIGS. 2 to 4 show examples of display images on  
a liquid crystal display unit;

FIG. 5 is a block diagram showing an internal structure of a control circuit in the digital copying machine;

5        FIGS. 6, 7, 12 and 13 are flow charts illustrating printing processes;

      FIGS. 8A to 8E and 14A to 14E are views for describing printing processes at the time the portrait of the horizontally positioned original is set;

10       FIGS. 9A to 9E and 15A to 15E are views for describing printing processes at the time the landscape of the vertically positioned original is set;

      FIGS. 10A to 10E and 16A to 16E are views for describing printing processes at the time the landscape of the horizontally positioned original is set or the  
15       horizontally positioned original is automatically set;  
      and

      FIGS. 11A to 11E and 17A to 17E are views for describing printing processes at the time the portrait of the vertically positioned original is set or the  
20       vertically positioned original is automatically set.

#### DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present invention will now be described with reference to the accompanying drawings.

25       FIG. 1 is a cross-sectional view showing a schematic structure of a digital copying machine 1 as an example of an image forming apparatus according to the present invention.

8b  
9a-  
As is shown in FIG. 2, the digital copying machine 1 has an apparatus body 2. The apparatus body 2 includes a scanner unit 4 serving as reading means and a printer unit 6 functioning as image forming means.

5           An original table 8 formed of transparent glass, on which an object to be read, that is, an original D, is placed, is provided on a top surface of the apparatus body 2. In addition, an automatic original document feeder 9 (hereinafter "ADF") serving as means  
10           for automatically feeding the original D onto the original table 8 is provided on the top surface of the apparatus body 2.

          The original D placed on an original tray 9a of the ADF 9 is conveyed by a convey guide (not shown) and  
15           fed onto a discharge tray 9c via a platen roller 9b. Accordingly, while the original D is being conveyed by the platen roller 9b, it is exposed and scanned by an exposure lamp 10 of the scanner unit 4, as will be described later, and an image on the original D is  
20           read.

          The originals D are set on the original tray 9a of the ADF 9 such that surfaces to be read of the originals D may face upward. The originals D are successively fed in from the uppermost one.

25           The scanner unit 4 provided within the apparatus body 2 includes the exposure lamp 10 constituted by, e.g. a halogen lamp, serving as a light source for



illuminating the original D fed by the ADF 9 or the original D placed on the original table 8, and a first mirror 12 for deflecting reflection light from the original D to a predetermined direction. The exposure  
5 lamp 10 and first mirror 12 are attached to a first carriage 14 disposed below the original table 8.

The first carriage 14 is disposed to be movable in parallel to the original table 8. The first carriage 14 is reciprocally moved under the original table 8 by  
10 a scanner motor (drive motor) 16 via a toothed belt, etc. (not shown). The scanner motor 16 is constituted by, e.g. a stepping motor.

A second carriage 18 movable in parallel to the original table 8 is disposed below the original table  
15 8. Second and third mirrors 20, 22 for successively deflecting the reflection light from the original D, which has been reflected by the first mirror 12, are attached to the second carriage 18 such that the second and third mirrors 20, 22 are arranged at right angles  
20 with each other. A torque from the scanner motor 16 is transmitted to the second carriage 18 by means of the toothed belt, etc. which drives the first carriage 14, and the second carriage 18 is driven following the first carriage 14. In addition, the second carriage  
25 18 is moved in parallel to the original table 8 at a speed corresponding to 1/2 of the speed of the first carriage 14.

Moreover, a focusing lens 24 for focusing the reflection light from the third mirror 20 on the second carriage 18 and a CCD sensor (line sensor) 26 for photoelectrically converting the reflection light focused by the focusing lens 24 are disposed below the original table 8. The focusing lens 24 is disposed in a plane including an optical axis of the light deflected by the third mirror 22 so as to be movable by means of a driving mechanism. The focusing lens 24, by its own movement, focuses the reflection light with a desired magnification (main scan direction). The CCD sensor 26 photoelectrically converts the incident reflection light in accordance with an image processing clock delivered from a main CPU (to be described later) and outputs an electric signal corresponding to the read original D. The magnification in a sub-scan direction can be controlled by altering the feed speed of the ADF 9 or the speed of movement of the first carriage 14.

800 →  
When the original D fed by the ADF 9 is read, the position of radiation of the exposure lamp 10 is fixed at a position shown in FIG. 2. When the original D placed on the original table 8 is read, the position of radiation of the exposure lamp 10 is moved from the left to the right along the original table 8.

On the other hand, the printer unit 6 includes a laser exposure device 28 functioning as latent image

forming means. A peripheral surface of a photosensitive drum 30 is scanned by a laser beam from the laser exposure device 28 and thus an electrostatic latent image is formed on the peripheral surface of the photosensitive drum 30.

*gdn*

~~In addition, the printer unit 6 includes the~~  
photosensitive drum 30 which is rotatable and serves as an image carrying body. The photosensitive drum 30 is disposed on a right side of an almost central region in the apparatus body 2. The peripheral surface of the photosensitive drum 30 is exposed by the laser beam from the laser exposure device 28 and a desired electrostatic latent image is formed thereon. Around the peripheral surface of the photosensitive drum 30, there are successively provided an electrifying charger 32 for electrifying the drum peripheral surface with a predetermined charge; a developer 34 serving as developing means for supplying toner as developing agent onto the electrostatic latent image formed on the peripheral surface of the photosensitive drum 30 and developing the electrostatic latent image with a desired image density; a transfer charger 38 integrally including a separating charger 36 for separating from the photosensitive drum 30 an image formation medium, i.e. a copying paper sheet P, fed from a cassette 48, 50 (to be described later), the transfer charger 38 functioning to transfer the toner

803  
5 image formed on the photosensitive drum 30 onto the  
sheet P; a separation claw 40 for separating the  
copying paper sheet P from the peripheral surface of  
the photosensitive drum 30; a cleaner 42 for cleaning  
the toner remaining on the peripheral surface of  
the photosensitive drum 30; and a destaticizer 44  
for de-electrifying the peripheral surface of the  
photosensitive drum 30.

10 An upper cassette 48 and a lower cassette 50,  
which are removable from the apparatus body, are  
disposed in a stacked fashion in a lower region of  
the apparatus body 2. Copying paper sheets P with  
different sizes are put in the respective cassettes  
48, 50. A manual feed tray 54 is provided on a lateral  
15 side of the upper cassette 48.

A convey path 56 is defined within the apparatus  
body 2, which extends from each cassette 48, 50 through  
a transfer section provided between the photosensitive  
drum 30 and transfer charger 38. At a terminal end of  
20 the convey path 56, there is provided a fixing device  
58 having a fixing lamp 58a. A discharge port 60 is  
formed at an upper part of the fixing device 58.

25 A feed roller 62 and a separation roller 63 for  
taking out paper sheets P one by one from each cassette  
48, 50 are provided near each cassette 48, 50. The  
convey path 56 is provided with a number of feed roller  
pairs 64 for conveying through the convey path 56 the

copying paper sheets P taken out by the feed roller 62 and separation roller 63.

5 A register roller pair 66 is provided on an upstream side of the photosensitive drum 30 in the convey path 56. The register roller pair 66 corrects a skew of the taken-out copying paper sheet P, aligns a top end of the toner image on the photosensitive drum 30 with a top end of the copying paper sheet P, and feeds the copying paper sheet P to the transfer section at the same speed as the speed of movement of the peripheral surface of the photosensitive drum 30. A pre-aligning sensor 68 for sensing arrival of the copying paper sheet P is provided on an upstream side of the register roller pair 66, that is, on the feed roller 64 side.

15 The copying paper sheet P taken out from the cassette 48, 50 one by one by means of the feed roller 62 is fed to the register roller pair 66 by means of the feed roller pair 64. After the top end of the copying paper sheet P has been aligned by the register roller pair 66, the copying paper sheet P is fed to the transfer section.

~~In the transfer section, the developed image, that is, the toner image, formed on the photosensitive drum 30 is transferred onto the sheet P by the transfer charger 38. The copying paper sheet P on which the toner image has been transferred is separated from the~~

Sub  
25

~~peripheral surface of the photosensitive drum 30 by the~~  
functions of the separating charger 36 and separating  
claw 40. The copying paper sheet P is then conveyed to  
the fixing device 58 by a convey belt (not shown)  
5 constituting a part of the transfer path 56. After the  
developing agent image is melted and fixed on the  
copying paper sheet P by the fixing device 58, the  
copying paper sheet P is discharged by a discharge  
roller pair 70 onto a discharge tray 72 within the  
10 apparatus body 2 through the discharge port 60.  
An automatic double-side device 74 for reversing the  
copying paper sheet P, which has passed through the  
fixing device 58, and feeding it to the convey path 56  
once again, is provided on a right side of the convey  
15 path 56.

An operation panel (to be described later) for  
instructing various copying conditions, such as copying  
magnification, and a copying operation start, is  
provided on an upper front portion of the apparatus  
20 body 2.

As is shown in FIG. 2, the operation panel is  
provided with a liquid crystal display (LCD) unit 86  
including touch keys for effecting operation guidance  
and various instructions.

~~The LCD unit 86, as shown in FIG. 2, comprises~~  
an operation guidance display portion 86a displaying  
operation guidance of "READY", etc. and a setting

~~display portion 76b displaying various setting contents~~  
in a switched manner. The setting display portion 86b,  
for example, displays a setting screen of a basic  
function (BASIC) as an initial screen, as shown in  
5 FIG. 2. This screen shows a selection state of LCF 52,  
indicates that a zoom ratio is 100% and an original  
size is A4, and displays setting of a photo image and a  
text image, setting of non-sort/non-staple and setting  
of a double-side mode, and also displays icons for  
10 instructing editing, programs and change of settings.

In addition, the setting display portion 86b  
can display setting screens for application  
(EDIT), programs (PROGRAM) and setting (SETTINGS).  
For example, on the setting screens for programs and  
15 settings, the priority can be set, jobs canceled,  
a list of jobs displayed, and the setting of priority  
altered or added.

If the double-side mode is set on the initial  
screen shown in FIG. 2, a setting screen for directions  
20 of images is displayed as shown in FIG. 3. This screen  
displays an icon 87a for setting "AUTO" of a horizon-  
tally positioned original and "AUTO" of a vertically  
positioned original, an icon 87b for setting "PORTRAIT"  
of a horizontally positioned original and "PORTRAIT"  
25 of a vertically positioned original, and an icon 87c  
for setting "LANDSCAPE" of a horizontally positioned  
original and "LANDSCAPE" of a vertically positioned

8b  
86b

original.

When the icon for application (EDIT) is depressed, a setting screen for a binding margin, as shown in FIG. 4, is displayed. If setting of the binding margin is selected on this screen, the binding margin in the double-side mode can be set.

The digital copying machine 1 may be used as an independent unit, or as a network printer.

In this case, the digital copying machine 1 is connected to personal computers (PC) (not shown) or a server (not shown) via a local network (LAN) (not shown).

The internal structure of a control circuit of the digital copying machine 1 will now be described with reference to FIG. 5.

The digital copying machine 1 is provided with a main control unit 90 for controlling the entirety of the machine. The main control unit 90 comprises, though not shown, a CPU (central processing unit) for controlling the operation thereof, a ROM (Read only memory) storing software associated with the operation of the digital copying machine 1, and a RAM (random access memory) (S-RAM) for temporarily storing image data and data on operations.

The main control unit 90 is connected to the ADF 9, scanner unit 4, printer unit 6, operation panel 91, image processing unit 92, page memory 93 and HDD 94 via



a bus 95. The image processing unit 92, page memory 93 and HDD 94 are connected via an image bus 96.

5 In the main control unit 90, binding axes are determined on the basis of settings of the directions of images. Specifically, in the case of the auto-mode of the vertically positioned original, the portrait of the vertically positioned original and the portrait of the horizontally positioned original, the binding axis is determined to be the longitudinal direction. In the  
10 case of the auto-mode of the horizontally positioned original, the landscape of the horizontally positioned original and the landscape of the vertically positioned original, the binding axis is determined to be the transverse direction.

15 The image processing unit 92 processes the original image read by the scanner unit 4, processes the image data from the page memory 93 and HDD 94, and outputs the processed image data to the page memory 93, printer unit 6 or HDD 94.

20 The image processing unit 92 includes a compression/decompression circuit (not shown). Using the compression/decompression circuit, the image processing unit 92 compresses image data from the page memory 93 or decompresses image data from the HDD 94.

25 The page memory 93 record image data from the image processing unit 92.

The HDD 94 is an external memory device,

represented by a hard disk, for recording various data.  
For example, when a plurality of copies are made,  
compressed images of scan images of plural originals  
are recorded. At the time of printing, the compressed  
5 images are read out and printed.

The main control unit 91 has input tasks and print  
tasks managed for each job.

A process of successively reading originals D  
placed on the tray 9a of the ADF 9 and performing a  
10 double-side printing operation in the above-described  
structure will now be described with reference to flow  
charts of FIGS. 6 and 7.

To start with, a plurality of originals D are set  
on the original tray 9a of the ADF 9 with their  
15 surfaces to be read facing upward (ST1). The operator  
sets a double-side mode on the setting display portion  
86b of the LCD unit 86 (ST2). Using the setting  
display portion 86b of the LCD unit 86, the main  
control unit 90 displays the screen for setting various  
20 states of originals in the double-side mode, as shown  
in FIG. 4.

A description will now be given of a case where  
the portrait of the horizontally positioned original of  
the icon 87b has been set on the basis of this display  
25 (ST11) and a copy start key (not shown) has been turned  
on (ST12).

A first original D is conveyed by the ADF 9 and,

as shown in FIG. 8A, image data of each scan line in the main scan direction (the transverse direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the sub-scan direction (the longitudinal direction of the original) (ST13). The read image data is subjected to a mirror-image conversion, as shown in FIG. 8B, and recorded on the page memory 93 (ST14). On the basis of the image data recorded on the page memory 93, the main control unit 90 determines the width in the main scan direction and size of the original D.

After the image on the one-page original has been recorded on the page memory 93, the image data of each scan line in the main scan direction is successively read out from the page memory 93 without performing a rotational process ( $0^\circ$ ), as shown in FIGS. 8B and 8C (ST15). An electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28 which corresponds to the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34. On the other hand, a paper sheet is fed from the cassette which stores paper sheets P having the same size as the original D and conveyed to a point before the transfer section. The copying paper sheet P is then conveyed in synchronism with the developed image on the photosensitive drum 30, and the image data of

the original D is transferred onto the surface of the copying paper sheet P having the same size as the original D. Following this, the image data is fixed by the fixing device 58. Thus, printing on the obverse  
5 side is effected as shown in FIG. 8E (ST16).

A portion of the copying paper sheet P, with some length from its front end, is discharged from the discharge port 60 by the discharge roller 70. Then, the copying paper sheet P is conveyed in the reverse  
10 direction and guided to the automatic double-side device 74 by a diverting mechanism (not shown). Thus, the copying paper sheet P is reversed and conveyed once again to the convey path 56 before the register roller pair 66.

On the other hand, a second document D is conveyed by the ADF 9 and, as shown in FIG. 8A, image data of each scan line in the main scan direction (the transverse direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the  
15 sub-scan direction (the longitudinal direction of the original) (ST17). The read image data is subjected to a mirror-image conversion, as shown in FIG. 8B, and recorded on the page memory 93 (ST18). On the basis of the image data recorded on the page memory 93, the main  
20 control unit 90 determines the width in the main scan direction and size of the original D. In this case, if the width in the main scan direction and size of the  
25

second original D differ from those of the first document D, the process is halted.

Where the widths in the main scan direction and sizes of both originals D are the same, the image on the one-page original is recorded on the page memory 93. Then, as shown in FIGS. 8B and 8D, a rotational process of  $180^\circ$  is performed and the image data is recorded on the page memory 93 once again. The image data of each scan line in the main scan direction of the rotated image is successively read out from the page memory 93 (ST19). An electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28 which corresponds to the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34.

On the other hand, a copying paper sheet P is fed from the automatic double-side device 74, and the image data of the original D is transferred onto the reverse side of the copying paper sheet P in the transfer section. Following this, the image data is fixed by the fixing device 58. Thus, printing on the reverse side is effected as shown in FIG. 8E (ST20). The copying paper sheet P is discharged from the discharge port 60 onto the discharge tray 72.

Thereafter, the presence/absence of the original D on the original tray 9a is determined (ST21). If the

original D is present, control returns to step 13.

If the original D is absent, the process is finished.

As a result, in the state in which the portrait of the horizontally positioned original is set, the images regularly arranged in the same direction with reference to the longitudinal direction of the originals D (copying paper sheet P) are printed on the obverse side and reverse side of the copying paper sheet P, as shown in FIG. 8E.

A description will now be given of a case where the landscape of the vertically positioned original of the icon 87c has been set (ST31) in the state in which the double-side mode is set in step 2 and the copy start key (not shown) has been turned on (ST32).

A first original D is conveyed by the ADF 9 and, as shown in FIG. 9A, image data of each scan line in the main scan direction (the longitudinal direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the sub-scan direction (the transverse direction of the original) (ST33). The read image data is subjected to a mirror-image conversion, as shown in FIG. 9B, and recorded on the page memory 93 (ST34). On the basis of the image data recorded on the page memory 93, the main control unit 90 determines the width in the main scan direction and size of the original D.

After the image on the one-page original has been

recorded on the page memory 93, the image data of each scan line in the main scan direction is successively read out from the page memory 93 without performing a rotational process ( $0^\circ$ ), as shown in FIGS. 9B and 9C (ST35). An electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28 which corresponds to the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34.

On the other hand, a paper sheet is fed from the cassette which stores paper sheets P having the same size as the original D and conveyed to a point before the transfer section. The copying paper sheet P is then conveyed in synchronism with the developed image on the photosensitive drum 30, and the image data of the original D is transferred onto the surface of the copying paper sheet P having the same size as the original D. Following this, the image data is fixed by the fixing device 58. Thus, printing on the obverse side is effected as shown in FIG. 9E (ST36).

A portion of the copying paper sheet P, with some length from its front end, is discharged from the discharge port 60 by the discharge roller 70. Then, the copying paper sheet P is conveyed in the reverse direction and guided to the automatic double-side device 74 by the diverting mechanism (not shown). Thus, the copying paper sheet P is reversed and

conveyed once again to the convey path 56 before the register roller pair 66.

On the other hand, a second document D is conveyed by the ADF 9 and, as shown in FIG. 9A, image data  
5 of each scan line in the main scan direction (the longitudinal direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the sub-scan direction (the transverse direction of the original) (ST37). The read image data is subjected to  
10 a mirror-image conversion, as shown in FIG. 9B, and recorded on the page memory 93 (ST38). On the basis of the image data recorded on the page memory 93, the main control unit 90 determines the width in the main scan direction and size of the original D. In this case, if  
15 the width in the main scan direction and size of the second original D differ from those of the first document D, the process is halted.

Where the widths in the main scan direction and sizes of both originals D are the same, the image on  
20 the one-page original is recorded on the page memory 93. Then, as shown in FIGS. 9B and 9D, a rotational process of  $180^\circ$  is performed and the image data is recorded on the page memory 93 once again. The image data of each scan line in the main scan direction of  
25 the rotated image is successively read out from the page memory 93 (ST39). An electrostatic latent image (exposure image) is formed on the photosensitive drum



30 by a laser beam from the laser exposure device 28 which corresponds to the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34.

5           On the other hand, a copying paper sheet P is fed from the automatic double-side device 74, and the image data of the original D is transferred onto the reverse side of the copying paper sheet P in the transfer section. Following this, the image data is fixed by  
10           the fixing device 58. Thus, printing on the reverse side is effected as shown in FIG. 9E (ST40). The copying paper sheet P is discharged from the discharge port 60 onto the discharge tray 72.

          Thereafter, the presence/absence of the original D  
15           on the original tray 9a is determined (ST41). If the original D is present, control returns to step 33. If the original D is absent, the process is finished.

          As a result, in the state in which the landscape of the vertically positioned original is set, the  
20           images regularly arranged in the same direction with reference to the transverse direction of the originals D (copying paper sheet P) are printed on the obverse side and reverse side of the copying paper sheet P, as shown in FIG. 9E.

25           A description will now be given of a case where the landscape of the horizontally positioned original of the icon 87c has been set or the auto-mode of the

horizontally positioned original of the icon 87a has been set (ST51) in the state in which the double-side mode is set in step 2 and the copy start key (not shown) has been turned on (ST52).

5           A first original D is conveyed by the ADF 9 and, as shown in FIG. 10A, image data of each scan line in the main scan direction (the transverse direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the sub-scan direction  
10           (the longitudinal direction of the original) (ST53). The read image data is subjected to a mirror-image conversion, as shown in FIG. 10B, and recorded on the page memory 93 (ST54). On the basis of the image data recorded on the page memory 93, the main control unit  
15           90 determines the width in the main scan direction and size of the original D.

          After the image on the one-page original has been recorded on the page memory 93, the image data of each scan line in the main scan direction is successively  
20           read out from the page memory 93 without performing a rotational process ( $0^\circ$ ), as shown in FIGS. 10B and 10C (ST55). An electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28 which corresponds to  
25           the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34. On the other hand, a paper sheet is fed from the

cassette which stores paper sheets P having the same size as the original D and conveyed to a point before the transfer section. The copying paper sheet P is then conveyed in synchronism with the developed image on the photosensitive drum 30, and the image data of the original D is transferred onto the surface of the copying paper sheet P having the same size as the original D. Following this, the image data is fixed by the fixing device 58. Thus, printing on the obverse side is effected as shown in FIG. 10E (ST56).

A portion of the copying paper sheet P, with some length from its front end, is discharged from the discharge port 60 by the discharge roller 70. Then, the copying paper sheet P is conveyed in the reverse direction and guided to the automatic double-side device 74 by the diverting mechanism (not shown). Thus, the copying paper sheet P is reversed and conveyed once again to the convey path 56 before the register roller pair 66.

On the other hand, a second document D is conveyed by the ADF 9 and, as shown in FIG. 10A, image data of each scan line in the main scan direction (the transverse direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the sub-scan direction (the longitudinal direction of the original) (ST57). The read image data is subjected to a mirror-image conversion, as shown in FIG. 10B, and

recorded on the page memory 93 (ST58). On the basis of the image data recorded on the page memory 93, the main control unit 90 determines the width in the main scan direction and size of the original D. In this case,  
5 if the width in the main scan direction and size of the second original D differ from those of the first document D, the process is halted.

Where the widths in the main scan direction and sizes of both originals D are the same, the image on  
10 the one-page original is recorded on the page memory 93. Then, as shown in FIGS. 10B and 10D, without performing a rotational process ( $0^\circ$ ), the image data of each scan line in the main scan direction is successively read out from the page memory 93 (ST59).

15 An electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28 which corresponds to the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34.

20 On the other hand, a copying paper sheet P is fed from the automatic double-side device 74, and the image data of the original D is transferred onto the reverse side of the copying paper sheet P in the transfer section. Following this, the image data is fixed by  
25 the fixing device 58. Thus, printing on the reverse side is effected as shown in FIG. 10E (ST60). The copying paper sheet P is discharged from the discharge

port 60 onto the discharge tray 72.

Thereafter, the presence/absence of the original D on the original tray 9a is determined (ST61). If the original D is present, control returns to step 53.

5 If the original D is absent, the process is finished.

As a result, in the state in which the landscape of the horizontally positioned original is set or the auto-mode of the horizontally positioned original is set, the images regularly arranged in the same  
10 direction with reference to the transverse direction of the originals D (copying paper sheet P) are printed on the obverse side and reverse side of the copying paper sheet P, as shown in FIG. 10E.

A description will now be given of a case where  
15 the portrait of the vertically positioned original of the icon 87b has been set or the auto-mode of the vertically positioned original of the icon 87a has been set (ST71) in the state in which the double-side mode is set in step 2 and the copy start key (not shown) has  
20 been turned on (ST72).

A first original D is conveyed by the ADF 9 and, as shown in FIG. 11A, image data of each scan line in the main scan direction (the longitudinal direction of the original) is successively read by the CCD sensor  
25 26 of the scanner unit 4 in the sub-scan direction (the transverse direction of the original) (ST73). The read image data is subjected to a mirror-image conversion,

as shown in FIG. 11B, and recorded on the page memory 93 (ST74). On the basis of the image data recorded on the page memory 93, the main control unit 90 determines the width in the main scan direction and size of the original D.

After the image on the one-page original has been recorded on the page memory 93, the image data of each scan line in the main scan direction is successively read out from the page memory 93 without performing a rotational process ( $0^\circ$ ), as shown in FIGS. 11B and 11C (ST75). An electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28 which corresponds to the read-out image data, and this electrostatic latent image is developed (visualized) by the developer 34. On the other hand, a paper sheet is fed from the cassette which stores paper sheets P having the same size as the original D and conveyed to a point before the transfer section. The copying paper sheet P is then conveyed in synchronism with the developed image on the photosensitive drum 30, and the image data of the original D is transferred onto the surface of the copying paper sheet P having the same size as the original D. Following this, the image data is fixed by the fixing device 58. Thus, printing on the obverse side is effected as shown in FIG. 11E (ST76).

A portion of the copying paper sheet P, with some

length from its front end, is discharged from the discharge port 60 by the discharge roller 70. Then, the copying paper sheet P is conveyed in the reverse direction and guided to the automatic double-side  
5 device 74 by the diverting mechanism (not shown). Thus, the copying paper sheet P is reversed and conveyed once again to the convey path 56 before the register roller pair 66.

On the other hand, a second document D is conveyed  
10 by the ADF 9 and, as shown in FIG. 11A, image data of each scan line in the main scan direction (the longitudinal direction of the original) is successively read by the CCD sensor 26 of the scanner unit 4 in the sub-scan direction (the transverse direction of the  
15 original) (ST77). The read image data is subjected to a mirror-image conversion, as shown in FIG. 11B, and recorded on the page memory 93 (ST78). On the basis of the image data recorded on the page memory 93, the main control unit 90 determines the width in the main scan  
20 direction and size of the original D. In this case, if the width in the main scan direction and size of the second original D differ from those of the first document D, the process is halted.

Where the widths in the main scan direction and  
25 sizes of both originals D are the same, the image on the one-page original is recorded on the page memory 93. Then, as shown in FIGS. 11B and 11D, without

performing a rotational process ( $0^\circ$ ), the image data of each scan line in the main scan direction is successively read out from the page memory 93 and an electrostatic latent image (exposure image) is formed on the photosensitive drum 30 by a laser beam from the laser exposure device 28. The electrostatic latent image is developed (visualized) by the developer 34.

On the other hand, a copying paper sheet P is fed from the automatic double-side device 74, and the image data of the original D is transferred onto the reverse side of the copying paper sheet P in the transfer section. Following this, the image data is fixed by the fixing device 58. Thus, printing on the reverse side is effected as shown in FIG. 11E (ST79, 80).

The copying paper sheet P is discharged from the discharge port 60 onto the discharge tray 72.

Thereafter, the presence/absence of the original D on the original tray 9a is determined (ST81). If the original D is present, control returns to step 73.

If the original D is absent, the process is finished.

As a result, in the state in which the portrait of the vertically positioned original is set or the auto-mode of the vertically positioned original is set, the images regularly arranged in the same direction with reference to the longitudinal direction of the originals D (copying paper sheet P) are printed on the obverse side and reverse side of the copying paper



sheet P, as shown in FIG. 11E.

The above-described example is directed to cases where images regularly arranged in the same direction are printed on the obverse and reverse sides of the copying paper sheet P in the double-side printing. Moreover, printing with provision of binding margins may be performed.

In this case, as illustrated in flow charts of FIGS. 12 and 13, a step 3 for a binding margin setting process is added between step 2 and step 11 in the flow chart of FIG. 6. Besides, the contents of steps 15 and 19 in the flow chart of FIG. 6 and the contents of steps 35, 39, 55, 59, 75 and 79 in the flow chart of FIG. 7 are replaced with the contents of steps 15', 19', 35', 39', 55', 59', 75' and 79' in which the binding margins are provided.

In steps 15', 19', 75' and 79', the binding axis of the binding margin is set with reference to the longitudinal direction of the original D (copying paper sheet P). A binding margin having a width in the transverse direction is provided with reference to the binding axis.

In steps 35', 39', 55' and 59', the binding axis of the binding margin is set with reference to the transverse direction of the original D (copying paper sheet P). A binding margin having a width in the longitudinal direction is provided with reference to

the binding axis.

As has been described above, when double-side printing is effected on a single copying paper sheet to produce images of two originals thereon, the directions  
5 of images on the originals can be considered. Even where the directions of images on originals, which can be positioned only horizontally due to the structure of the copying machine, are the portrait and landscape, the printing according to the directions of images can  
10 be made.

Even in the case of originals which can be positioned vertically and horizontally, the originals can be set (for input) in conformity to the direction of paper sheets set in the machine and the printing  
15 with regulated directions of images can be made by setting the directions of images. More specifically, even where a vertically positioned original is set horizontal for printing, the same printing result as in the case where it is set vertical can be obtained and  
20 the performance of the copying machine is enhanced.

The above embodiment is directed to cases where directions of images are set in the double-side mode and the binding margin is set on the LCD unit of the operation panel. Where the copying machine is used  
25 as the aforementioned network printer, however, the setting may be made from the personal computers (PC) or server connected via the local network (LAN).